A conceptual framework to evaluate suppliers for building infrastructure in the Malaysian electricity supply industry

S. Thiruchelvam, J.E. Tookey, J.O.B. Rotimi and D.A.S. Samarasinghe
Construction Management, School of Engineering, Auckland University of Technology,
Private Bag 92006, Auckland 1020, New Zealand
sthiruch@aut.ac.nz; jtookey@aut.ac.nz; jrotimi@aut.ac.nz; asamaras@aut.ac.nz

K. N. Mustapha,
College of Engineering, Universiti Tenaga Nasional,
Km 7, Jalan IKRAM-UNITEN, 43000 Kajang, Selangor, Malaysia
Kamal@uniten.edu.my

K.Kadirgama,
Department of Mechanical Engineering, Universiti Malaysia Pahang,
26300 Kuantan, Pahang, Malaysia
kumaran@ump.edu.my

Abstract

In the current competitive business environment the relationship between buyers and suppliers is no longer antagonistic. Emphasis has shifted to the forging of partnerships that benefits all parties in any business setting. The emergence of supply chain concepts have brought about the realization of long-term cooperation based on mutual trusts. Frequently high priority is given towards suppliers that are able to deliver, and are committed to buyer's business objectives. However, proper supplier selection is pertinent to meeting these business objectives as it dictates operational and financial positions. The current study discusses a construct that could facilitate supplier selection in a typical government linked company. It presents the key items that could be considered in a supplier selection metric using a comprehensive approach. The study is an aspect of a doctoral research programme that aims to develop a supplier selection model for an electricity supply organization. The paper concludes that having a good set of supplier selection metric is of critical importance to business success in any supply chain.

Keywords: Supplier selection, decision-making, power utility, Malaysia

1. Introduction

Supplier selection is a decision-making process which deserves more attention due to its contribution to organizational operational and financial positions (Hsu, Kannan, Leong, & Tan, 2006; Lin, Chow, Madu, Kuei, & Yu, 2005). The success of the supply chain created by

an organization is reliant on the competency of the suppliers. Hence, supplier selection per se is of the essence for any Supply Chain Management (SCM) system. For good buyer-supplier relationships, the buyer has to reduce its supply base through effective supplier selection process (Sarkar & Mohapatra, 2006). In order to select the right suppliers for a supply chain, it can therefore be construed that there is a need to objectively evaluate suppliers. The overall intention of supplier selection is to determine the optimal supplier offering the best all-around package of product and services for the customer (Swift, 1995). For all these reasons, myriad of studies have been undertaken to find out what variables will affect the supplier selection and how to measure their degree of influence.

The decision-making process for evaluating and selecting a supplier is complicated as: (1) suppliers can be evaluated by more than one criterion; and (2) each supplier has a different specialty and thus a different criterion (Park, Shin, Chang, & Park, 2010). In the past, price has always been a key consideration in selecting a supplier (Degraeve & Roodhooft, 1999). Over the years however, buyers have realized that the cheapest supplier may not necessarily be the best but could potentially introduce additional cost into their value chain. In today's turbulent business environment, the pressure faced by organizations to minimize the purchasing costs drives buyers to revisit their decision-making criteria. This has resulted in a wide range of criteria proposed as selection criteria for the optimal supplier. Price is becoming less of a focus as companies turn their attention on non-price factors. This has resulted in purchasing officers constantly having to make a decision on whether to give more importance to price or non-price attributes (Min, 1994). Moreover, criteria for supplier selection are also constantly subjected to change as information technology and progress permeates an organization (Khurrum, 2003). Cheraghi, Dadashzadeh, and Subramaniam (2004, p. 91) further explain that "supplier selection criteria will continue to change based on an expanded definition of excellence to include traditional aspects of performance (quality, delivery, price, and service) in addition to non-traditional, evolving ones (just-in-time(JIT), communication, process improvement, and SCM)".

The dynamic nature of supplier selection criteria can sometimes create a conflict between purchasing officers and the organization. To keep abreast with global practices, an organization may want to adopt numerous and constant changes to its supplier selection criteria. However, these changes may not necessary be endorsed or agreed upon by its employees who are directly involved in purchasing and procurement activities. Many still believe that as the people directly involved in the buying process they should be given liberty

to implement their professional judgements on how a supplier should be selected (McDonald, 1996). From an academic perspective, the lack of congruence in preferred selection criteria between the buying organization and its purchasing officers suggests a missing link in existing practices. Therefore, this paper proposes a framework to compare criteria that influence the supplier selection and identify which criterion is the most important.

2. Literature Review

The identification and analysis of criteria for selection and evaluation of suppliers has been the central focus of many academicians and practitioners. Research on supplier selection criteria began in the early 1960s as vendor selection. The selection criteria are divided into quantitative and qualitative attributes. Basic criteria such as cost, quality, and delivery performance are still widely used. However, the range of criteria considered has evolved into a wider matrix parallel with the development of the SCM philosophy. An effective supplier selection model therefore, depends on the use of appropriate criteria that can reflect an organization's business strategy. The study on buyer-seller relationships by Cannon and Perreault (1999) argues that different criteria are needed in different purchasing situations. Therefore, it is impossible to have a universally applicable decision-making model with a fixed set of criteria. Criteria or metrics used in the supplier selection must reflect a strategic fit between the organization's business model and its supply chain strategy (Huang & Keskar, 2007).

The current scenario is that the supplier selection process has evolved into a wide spectrum of criteria (Lehmann & O'Shaughnessy, 1982). According to Beamon (1999) the criteria for performance measurement are required to satisfy the characteristics of inclusiveness (representative of all pertinent aspects), universality (allowance for comparison under various operating conditions), measurability (measurable data), and consistency (consistency to organization goals). Different researchers adopt diverse criteria in selecting suppliers, ranging from simple and basic to more complex attributes. However, Holmberg (2000) contends that some of these measurements are not derived from company's strategy and therefore do not support the business. Inappropriate and insufficient performance measurement could severely impact the overall organization's business performance. Therefore, it is important that the organization has at its disposal a succinctly developed metric with clear definitions of criteria that are aligned to the organization's objectives.

In the past, price was the sole factor in determining a suitable supplier. However, selection attributes have expanded and new ones have been introduced. In his seminal article, Dickson (1966) validated 23 criteria for assessing supplier's performance as listed in Table 1. According to respondents from 300 organizations, mainly manufacturing firms, the ability of each supplier to meet required quality is important. Price is the most important followed by quality, delivery, performance history, warranties and claim policies. Reciprocal arrangements are least important. Another important finding was that supplier selection criteria and their level of importance vary according to organizations. Weber, Current, and Benton (1991) re-examine Dickson's work by reviewing published works during 1966 to 1990. They reported that most of the researchers, 60% (47 out of 74) used multiple criteria as listed by Dickson for the selection process. They noted that the important JIT components such as quality, delivery, net price, geographical location and production facilities, and capacity are given priority by many purchasing firms.

Cheraghi, Dadashzadeh, and Subramaniam (2004) continue the review by analyzing works from the period between 1990 and 2001. They found that reliability, flexibility, consistency, and long-term relationship are significant new entrants of critical success factors for supplier selection. They concluded that criteria such as operating controls, packaging ability, training, business intention, warranties and claim policies are no longer relevant to the supplier selection in the current context. Technical capability also has significant impact on the evaluation process as the buying organization is concerned with the supplier's current and future technological capabilities. Other criteria that are important include a supplier's organisational chart and management structure as well as its financial standing which can help to assure the purchasing organization of its long term business viability and sustainability. The repair or maintenance standards of the supplier are also important in helping the organization in determining its customer service commitments. Suppliers are also evaluated on their past performances. Testimonials and references can be used as baseline for deciding on the reliability of a potential supplier.

As the market becomes more competitive, new criteria are beginning to emerge. Under the current SCM transformation edge, reliability and flexibility of each supplier are considered as key contributing factors. Flexibility is deemed to be a provision of value-added service to boost the business ties with the customer. The purchasing organization expects the supplier to be reliable in delivering required quantity products and services to the right destination, at the agreed upon time and in a contractually acceptable condition. Emphasis is also given to the

supplier's commitment towards continuous product development and improvement. Suppliers having continuous process improvement initiatives such as Total Quality Management (TQM), Six Sigma and ISO 9000 are regarded as being able to further enhance the standards of business operations. In order to minimize negative environmental impact from delivered products or rendered services, the supplier's ability to manage environmental factors is also considered in the selection process. In addition, supplier's commitment towards social responsibility and community development can create a good impression with the decision maker.

Although the issue of supplier selection is widely studied, only a few researchers have dedicated their efforts in developing metrics for choosing suitable supplier(s). In building a long-term partnership with suppliers, buyers need to determine suitable metrics and its definitions based from the suppliers and end-users input (Vonderembse & Tracey, 1999). As a part of the procurement policy and procedure, this will help the purchasing officers to have a consistent decision making process. Similarly, potential suppliers will benefit by having a clear understanding of the buyer's expectations. This paper will operationalize eighteen important criteria to organize the framework for supplier selection in the Malaysian power supply industry.

3. Research Method

3.1 Questionnaire

A questionnaire has been constructed of possible questions based from the literature review. The items were amended to reflect the situation in the Malaysian power supply industry and the study setting. As shown in Table 1, three main constructs (economic value, buyer-supplier relationship, and organizational system and technology) were measured using five-point Likert scale ('1' represents 'not at all important' and '5' represents 'extremely important'), except for the section on demographic and personal information. Likert scale is proposed because it can provide the respondents with the ability to state their level of agreement with the given statements (Black, 2005). For the purpose of this 500 questionnaires will be administered to a pool of 2500 engineers with purchasing experience. The respondents for the questionnaire will be selected through random sampling. The questionnaire is designed to be cross-sectional since it is planned to collect quantitative data only at one point in time.

Table 1: Perceptions on importance of each supplier selection criterion

Constructs	Code	Measures	Engineer's perception				
			1	2	3	4	5
Economic value (F1)	M1	Price					
	M2	Product quality					
	M3	Delivery					
Buyer-supplier relationship (F2)	M4	Support service					
	M5	Performance history					
	M6	Customer focus					
	M7	Customer training					
Organizational system and technology (F3)	M8	Flexibility					
	M9	Management and organization					
	M10	Financial performance					
	M11	Employee training and development					
	M12	Quality management system					
	M13	Safety awareness					
	M14	Environmental attributes					
	M15	Corporate social responsibility					
	M16	Production system					
	M17	Product innovation					
	M18	Information and communications technology					

3.2 Data Analysis

The data analysis will be conducted with IBM SPSS 19.0 and AMOS 19.0, including two steps: Exploratory Factor Analysis (EFA) and Confirmatory Factor Analysis (CFA).

3.2.1 Exploratory Factor Analysis (EFA)

EFA assists a researcher to establish the number of latent constructs (factors) underlying a set of variables (Bryne, 1998). The number of responses required for factors to be reliable depends on the data (Stevens, 2002). Kaiser-Meyer-Olkin (KMO) measure of sampling adequacy and Bartlett's test of spherecity will be used to review the appropriateness of the

data before performing the factor analysis. A KMO value of greater than 0.7 indicates the data is suitable for factor analysis. A low significance of the Bartlett's test of spherecity (p = 0.000) will also supports the adequacy of the data. To measure how strong the data is, the communality of each supplier selection criterion should be examined. The communality is the squared multiple correlation coefficient between a variable and all other variables in the analysis. The extraction of factors will be conducted using principal component analysis while Varimax rotation will be adopted to clarify the factors. Items with factor loadings with absolute value below than 0.5 will be discarded (Alexander, 1994). It is recommended to have at least three variables loading on each factor or preferably more (Hatcher, 1994). Overall Cronbach's Alpha (α) value will determine the internal consistency amongst the selected variables (Forza, 2009). Tukey (1977) asserts that preliminary results derived from EFA must be confirmed by the CFA which will be explained in the following section.

3.2.2 Confirmatory Factor Analysis (CFA)

Confirmatory Factor Analysis is the measurement model of structural equation modelling (SEM) (Schreiber, Stage, King, Nora, & Barrow, 2006). The main aim of CFA is to establish confidence in the measurement model which states the hypothesized relationships of the observed variables to the underlying constructs (Hurley et al., 1997). In this study, it is assumed that *economic value*, *buyer-supplier relationship*, and *organizational system and technology* influence each other as shown in Figure 1. Having established the confidence in the measurement model, a structural model will be performed to point out any causal relationships between the three factors. There are five steps for establishing SEM: specification, identification, estimation, testing, and modification (Fenlon, Sherriff, & Walter, 2000). AMOS 19.0 will be used to test and verify results from the previous section. The conceptual model will be evaluated using the chi-square (χ^2) statistic of absolute model fit and various descriptive model fit indices as shown in Table 2. The χ^2 value allows statements to be made regarding significance or hypothesis testing and other indices assess the goodness-of-fit (GOF) (Iacobucci, 2010). If some indices fail to meet the standard, the model will be modified according to the modifications indices from AMOS. The final model exhibits the significance of influence from each criterion towards supplier selection in the Malaysian power supply industry.

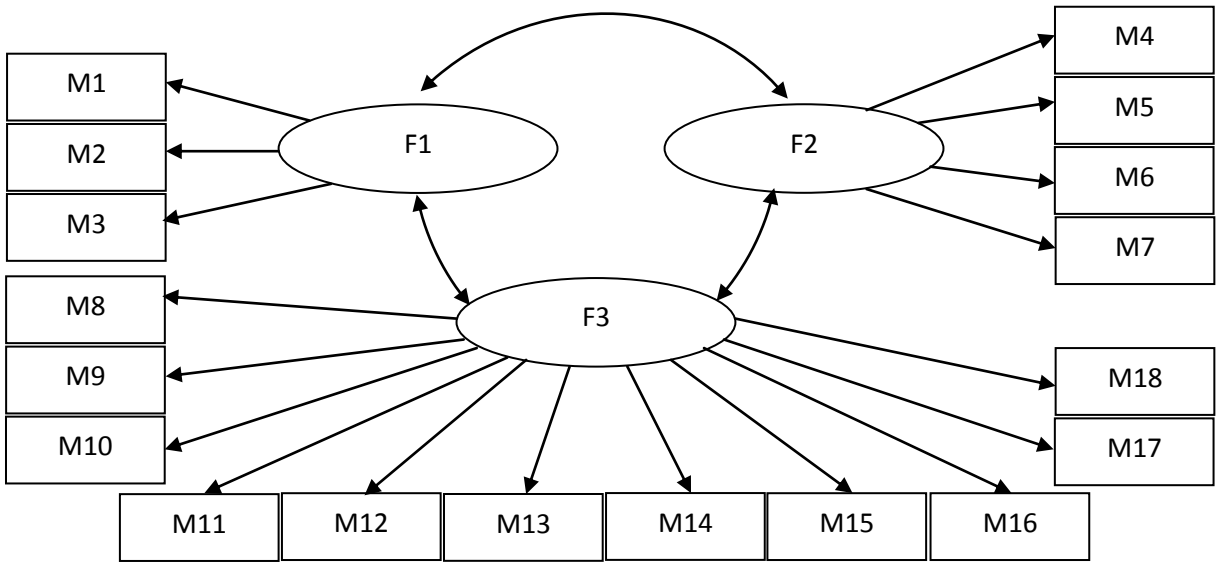

Figure 1: Proposed conceptual model for supplier selection in the power supply industry

Table 2: Fit indices reference values (Hsua et al., 2011)

	Index	Fit standards	Index	Fit standards
Chi-Square test	χ^2	p > 0.05		
Absolute fit indices	GFI	>0.9	RMSEA	≤0.05
	AGFI	>0.9	SRMR	<0.05
	RMR	<0.05		
Incremental fit indices	NFI	>0.9	IFI	>0.9
	NNFI	>0.9	RFI	>0.9
	CFI	>0.9		
Parsimonious fit indices	PGFI	>0.5	CN	>200
	NCP	~ 0	χ^2/df	<2

4. Conclusions

It is the intention of this research to provide a conceptual framework for supplier selection in the Malaysian power supply industry. While previous studies have identified myriad of criteria to be used for screening and selecting prospective suppliers, they have not identified the underlying dimensions of supplier selection in this industry. However, preliminary and anecdotal findings of the on-going doctoral research on which this paper is based, is indicative that the purchasing officers tend to look beyond price, quality, delivery, and service criteria in their decision-making. It was suggested throughout this paper that

purchasing decision-making in the power supply industry could be influenced by principal components of economic value, buyer-supplier relationship, and organizational system and technology. More so there have been no controlled studies related to purchasing decision-making issues, especially concerning power utilities in Malaysia. This reinforces the need for a study into issues around organizational buying behaviour in the electricity supply industry. The study identifies the appropriate supplier selection model using two main steps: EFA and CFA. Through these two steps, the authors will confirm the hypothesis and will take advantage of the results to improve supplier selection decision-making process. The study will benefit academics and practitioners as it could serve as a standard guideline for purchasing decision-making. Moreover, it can improve the transparency in the decision-making process. Subsequent findings will be published through this and other media.

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